GE Healthcare
Healthcare IT
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Federal Communications Commission
445 12th St., S.W.
Washington, D.C. 20554

Attn: "Comments—NBP Public Notice #17"

Re: GN Docket Nos. 09-47, 09-51, and 09-137; and WC Docket No. 02-60.

To Whom it May Concern:

On behalf of GE Healthcare, I am submitting comments from GE Healthcare on "Health Care Delivery Elements of National Broadband Plan - NBP Public Notice #17.

GE Healthcare IT is a division of the General Electric Company and a leading vendor of healthcare information technologies. Our products include health information exchange services, electronic medical records and practice management systems for independent physician practices, integrated enterprise clinical and financial systems, radiology information systems and PACS, enterprise revenue cycle management, electronic data interchange, pharmacy, lab, and perioperative and perinatal systems.

We have focused on Questions 2, 3 and 5.

Detailed Comments

2. Connectivity Requirements to Support Health IT Applications. Multiple health IT applications are being deployed using public and private communications networks. We seek to better understand the underlying IT infrastructure necessary to support successful implementation of current and emerging health IT applications, including:

a. General

Over the next 10-15 years, we expect Broadband to be an important enabler for new healthcare services. Some of the specific use cases are:

- *Getting data to a remote skilled specialist*
- *Getting information to the patient or a local caregiver*

Examples include:

- *collaboration*
- *in-home caregiver collaboration with in-hospital support*
- *robotic surgery*
- *video for consultation*
- *new imaging modalities e.g. highly portable ultrasound*
- *in-home apnea monitoring*
- *healthy lifestyle - behavior modification - social support -*
- *disaster support*
- *continuing education*
- *NLM - genome based data searches*

For a military model, see http://www.visicu.com/visitems/RemoteCriticalCareConsultation.pdf

See also this general link on healthcare broadband
http://dms.dartmouth.edu/nhtp/pdf/advancing_healthcare_broadband.pdf

a. Electronic health records

There is an increasing shift towards accessing electronic medical record (EMR) applications as software as a service (SaaS) offering, particularly for smaller provider organization that cannot afford in-house IT staff. This trend also includes the Patient Access and Billing related components that support the EMR. SaaS will be highly dependent on reliable broadband connections.

b. Real time video for Telehealth consultations and diagnoses

We see a shift to imaging display and review on MIDs, scalable from "phone" to "dedicated review workstation". This shift drives need for low-latency video as part of interactive image data set exploration using 3D and other data reduction visualizations of very large imaging datasets. Today, 3G is at the threshold which makes many tasks possible on mobile devices that were previously available only on dedicated workstations. We expect this change to drive a rapid need for more bandwidth to support new applications that integrate image manipulation, live video, and EMR data on a mobile device. The ability to specify higher QoS for these applications is essential.

c. Remote patient monitoring systems

This is definitely an area of likely growth that will require broadband capabilities for text and image data

d. Mobile and other portable remote monitoring systems

We are seeing an increased demand for "telestrations," in which experts in a specific clinical discipline are called in to direct diagnostic and interventional procedures in real time. These applications require live audio/video collaboration and may be augmented by specialized real-time clinical data displays such as fluroscopic images, vital signs, and stripcharts.

In addition, all EHR/EMR application are actively evolving mobile access capabilities, including both remote web and smartphone access.

e. Imaging

The impact of imaging applications on broadband and network needs is heavily reliant on several factors, the primary ones are:

1. Imaging volumes and modality types: What is the number of studies performed in a given day for each type of modality (MR, US, X-ray, NM, etc.)? The size of each study can fluctuate significantly by the type of modalities used to acquire the images.

2. Time of day distribution: What is the peak usage for a given time of day or range for the volume? Network bandwidth must support the peak load, even though it typically is significantly higher than the average volume of traffic.

3. Organizational geography: The distribution of acquisition modalities, interpreting physicians and referring physicians within the facilities of an organization often play a big role in the network utilization. For example, if an organization chooses to have a specialist read all Neuro CT studies from an office in Ohio but the acquisition devices are spread out across hospitals and clinics in multiple states, then there is a different amount of traffic than would result from an organization that has a generalist reading in each clinic location.

4. IT System Architecture: Much like the Organizational geography challenges, different technical approaches to the management of images have resulted in IT systems that have different network needs. Federated image storage, where the images are stored "local" to the acquisition devices or centralized image storage where all images are moved to a "single" storage location. Some systems combine the two strategies with both distributed "short-term" storage and centralized "long term" archival of images.

Note: As PHR and clinical decision support services are provided by an increasing number of content providers, we expect IDNs and Government agencies (e.g. the CDC) to require increased bandwidth and Healthcare IT infrastructure to scale their analytic capabilities. As an example, we reference the ADNI database of patient data relevant to Alzheimers disease staging. If this level of comprehensive imaging and lab report data were available for a population served by an IDN and routinely processed to improve outcomes with evidence-based protocol adjustments, it is easily foreseeable that IDN data center(s) would need to transport 2Gb/patient multiple times per year. Since a typical US household currently consumes ~10Gb/year, this shift could represent more than a doubling of required internet bandwidth overall

f. Other applications that enable or cause advanced healthcare delivery

- *B2B connectivity for electronic data interchange (EDI) eligibility, EDI claims, EDI remittances, lab interfaces and ePrescribing*
- *Consumer portals*
- *Data analytics and quality reporting services*
- *Health Information Exchange (HIE) support*
- *Various other hosted services (address validation, credit card transactions, etc) accessed on demand*

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2. For each relevant health IT application we seek:

i. What are the specific network requirements (e.g., bandwidth, latency, jitter, reliability, coverage, others)? How might these differ based upon the content (e.g., text, image, or video) of the application?

1. EMR applications: *We expect a bandwidth requirement of 20k per user. If we assume 3 users for every healthcare provider, we would be looking at a requirement of 60k per healthcare provider. Currently this usage is generally limited to text type data.*

Preliminary research shows that when image data are included, which is a critical and desirable trend for the future, bandwidth requirements can significantly increase- depending on actual workflow and practice. Requirements vary greatly, and depend, in part, on the type of visit. A ballpark estimate is 3 to 5 times the bandwidth requirement for text data, with the additional provision of a burst rate capacity of twice the base requirement to ensure that agreed upon quality of service can be maintained.

2. Patient Access and Billing applications that provide administrative, scheduling and billing support for EMR applications: *Bandwidth requirement can be supported within the 20k per user specification.*

3. Ancillary applications such as Laboratory, Pharmacy and Perioperative that extend the capability of EMR applicaitons.

4. B2B connectivity forEDI eligibility, EDI claims, EDI remittances, lab interfaces and ePrescribing: *Bandwidth requirement is typically 256k per site, with burst rates of up to 512k per site.*

5. Connected service offerings such as claim scrubbing components that are hosted as Internet based services: *Bandwidth requirement is typically 256k per site with burst rates of up to 512k per site.*

6. For connectivity between disparate IT applications interface engines are utilized by Healthcare Organizations (HCO). *Bandwidth requirements not yet determined.*

7. Consumer portals that provide direct patient access and interactions, including eHealth visits- this trend is rapidly accelerating with our customers: *Bandwidth impact is not defined but is likely to be significant and also require patients/consumer access to broadband.. Larger customers report active usage at the level of 100,000 patients. We expect this trend to increase as more capabilities are provided.*

8. Data mining and analysis applications that monitor compliance and produce quality performance reporting based on extracts from EMR products. De-identified information is accessed by other parties for research and analysis: *Referring to the estimate above, this could easily be 2Gb/patient multiple times per year if imaging data is included.*

9. Regional or community oriented health information sharing intiatives: *Bandwidth requirement is typically 256k per site with burst rates of up to 512k per site.*

General Discussion of Bandwidth Requirements for Health Information Exchange: Inpatient and Outpatient will have different bandwidth requirements, and the underlying technology (TEXT, CDA, PDF) used to create data content will have different impacts as well. From an overall bandwidth perspective, once you achieve reliable broadband service, bandwidth is unlikely to be a limiting factor, until one introduces imaging into the equation. For a provider seeing 30 patients a day, you are talking about the exchange of about 3 MB of data. For a 500 bed hospital, that would be about 25Mb of data. Assuming that a provider has typical DSL or better access, and that a hospital has typical internet access, it is not clear that this use will add much additional bandwidth to existing networks.[i]

10. Mobile healthcare: *Likely increased usage and associated bandwidth. For instance, inside an ambulance the EMTs may wish to do an ultrasound, and transmit the information to an emergency room. Using a cell phone connection may be problematic, as coverage is spotty; we are uncertain of the bandwidth needs.*

Note: Bandwidth requirements will be dependent upon how advanced the compression algorithms are as well as the rate distortion requirements for each particular type of data, ranging from video to genomic data. There are many specialized compression techniques suited for different types of medical data. Compression needs to be considered as part of any comprehensive study on this topic for medical communication systems.

11. Future targets for communication: *Not only communication to the patient, but communication at the nanoscale and molecular level in-vivo as implant communication improves. See http://www.research.ge.com/~bushsf/.*

ii. How might network requirements change (increase) to support application use across different delivery settings (e.g., solo physician practice versus five-physician practice versus clinic with 10 or more physicians)? How does concurrent application usage within a delivery setting affect network requirements?

For deployed EMR applications the basic requirement is 20k per user, with an average of 3 users representing one physician. For one provider, at least 60k would be required, for 3 providers that would scale linearly to 180k, and so on.

Concurrent, scalable installations will require more infrastructure capability, such as routers that are aware of medical imaging routing rules, and QoS implemented for video sharing applications.

iii. How might application usage by individuals (patients and doctors) both in their homes and on a mobile basis affect network requirements? How might these requirements vary by the content (e.g., text, image, or video) of the application?

Clearly, there is an increasing interest by patients in home access to healthcare information, and that access may be bidirectional as patient upload data to PHRs. Such data may be text but also from home monitoring devices. In addition, healthcare professionals increasingly access electronic health records and other HIT from home, using text, images (medical imaging, etc.), and video.

Fully diagnostic imaging applications can operate over the 300kbps connections found in many homes. Demand for such levels of service will increase when mobile devices are used to provide even more access to such data in a clinically usable form.

iv. What is the relative value of hosted (ASP, Software as a Service, or "in the cloud") solutions versus client-based offerings? How does solution type affect connectivity requirements, in terms of speed and reliability?

For smaller provider groups, SaaS has a number of advantages as the EMR platform, since it shields physicians from IT related complexity and lets them focus on healthcare. This model requires better QoS and reliable broadband access; broadband availability and reliability become a core part of the patient care. For example, decision support service are executed on a remote host in real time to identify a potential medication conflict for a patient that is being seen.

Imaging applications are headed in a direction of light integration at point of use and the heavy computation and data reduction happening in a distributed data center, or cloud.

3. Health IT Value Capture & Use Cases. Various health IT applications enabled by connectivity have been implemented in both public and private system settings. We seek to better understand the value case for health IT applications from real examples:

a. What combination(s) of health IT applications were implemented? What is the incremental value of adding applications and/or upgrading applications? For any given combination(s), we welcome detailed marginal costs and marginal benefits (financial and health) analyses of the applications chosen.

b. Where is application value captured? We seek to quantify the amount of healthcare cost reduction that may be attributed to availability of the following data types: text, image, and video (e.g., EHR's containing only text might offer X savings; EHR's with text plus images might offer 1.2X savings; EHR's with text plus images plus two-way video doctor-to-doctor consultation might offer 2X savings; 24/7 remote monitoring might offer 2.5X savings; etc.). How might the availability of these data elements and combinations thereof account for cost reduction and affect health outcomes?

As some basic imaging diagnostic read procedures become automated and usable by clinicians other than trained radiologists, we expect cost reductions. This change will require full fidelity images with automated processing to be delivered to point of care.

c. What was the network impact of installing health IT applications? We welcome studies of broadband usage before and after a health IT implementation.

d. Were connectivity infrastructure investments made? If so, we welcome detailed analyses of the cost of improvement as well as the specific technological upgrades.

This is less of an issue now than in the past, but upgrades to 1G or 10G networks from 100bT were common when radiology imaging systems such as PACS were first installed.

5. .Data Security in Health IT. Protection of personal health information (PHI) is required under HIPAA. We seek to better understand the measures in place to ensure health data security, the potential for breaches, and the network requirements to improve security.

Healthcare is fortunate to be following many other industries that have matured critical security technologies. Healthcare should be encouraged to use defense-in-depth including firewalls, intrusion detection, network layout, and drive-encryption for mobile devices; system-to-system security such as TLS with mutual-authentication; audit logging of security events leveraging audit analysis tools; and a wide variety of user authentication technologies that can be federated using SAML.

a. What are the major security challenges?

- *Where Healthcare has major security challenges is in the areas where Healthcare is different. These areas are not as numerous as once thought, but they are especially critical and hard to resolve.*
- *Patient Data is non-revocable. Credit-card numbers can be revoked, bank accounts closed.*
- *Data is authored (intellectual property) by one individual about another individual, leading to a sense of dual ownership.*
- *Errors in Data can result in Patient or Provider permanent harm. In most industries errors can be un-done or a remedy applied.*
- *Delay in Delivery can result in Patient or Provider permanent harm. A bank can delay transactions until systems are functioning*
- *Patient access to their data carries risks when that data has not been carefully explained to the patient. This issue may result in delayed access to the data, but should not be seen as a reason to block the data from the patient.*
- *Patient preferences on accessibility of their data. Most industries have much more classic Role-Based Access Control that classifies data and which roles have what kind of access.*
- *Outcomes research. The analysis of past outcomes can benefit society greatly, yet to do this analysis the prior patients' data must be accessed.*

b. What level of health data breaches exist in the current system?

Most health data breaches have been social attacks on the care providers that are authorized to access the data, where the social attack gets this care provider to expose data that should not be exposed. Most of these are detected using strong audit logs, which are a key solution to this problem.

c. What additional network demands do security efforts impose on the system?

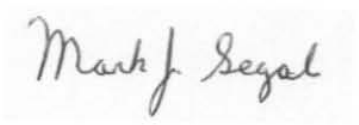
As stated above in 5.a, healthcare must be provided regardless of natural or man-made disasters and therefore must be very robust. It is this need for robustness that makes the use of national broadband interlinked networking very attractive.

d. How might the means by which patients obtain their medical information and populate Personal Health Records (PHRs) be simplified?

The PHR should not present more communications options but should enter into the creation of the Health Internet solution. Today healthcare providers, vendors, and infrastructure are working together to select and mature the standards using the HITSP/NHIN. The PHR vendors should engage and offer their expertise to build the solution.

GE Healthcare appreciates the opportunity to provide our comments on this critical national issue. For further questions, please feel free to contact me at the addresses indicated below.

Sincerely,



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[i] *Assumptions for the above:*

- *The text of a typical clinical document will range in size from 1 to 5Kb of data.*
- *The text of that same document in HL7 CDA format will take up from 5 to 25kb of data.*
- *That same document as a PDF could consume 10 - 50KB of data.*
- *A typical outpatient visit will generate 1-3 documents (the visit note, possibly a lab result, and maybe a CCD document sent to the patient's PHR). A typical inpatient visit is harder to estimate, but one could assume 1-2 documents per day for the patient, including progress notes, consults, and diagnostic test results (labs, imaging, EKG, et cetera).*
- *In the outpatient environment, assume a provider would always look at the most recent 1-2 documents (visit note and lab or other diagnostic test). In the inpatient environment, assume that providers would look at only the most recent 1-2 documents for a given stay (since most of the daily content would be in the hospital EMR, and so they would only need to look at the outside documents a few times). Viewing the documents will likely involve about 20Kb of data exchange before the documents themselves are accessed (using an XDS Query).*
- *Posting documents will likely involve an additional 1-5kb of data*
- *So, using CDA format: Assuming a provider sees 30 patients per day in an outpatient setting, that is 30 patients * (20-40 KB read + 20kb query + 20-40kb written + 5kb post) ~ 30 * 85KB ~ 2.5 Mb per provider per day. Round up to 3 just to be safe. Assuming a 500 bed hospital has about an 80% bed utilization rate (400 beds filled), 400 * 60 Kb = 24000 Kb or 24 Mb per day. Double or treble these figures if the majority of content is PDF.*

- *However, as people figure out how to better utilize this data, bandwidth requirements could double or treble, and then increase again as imaging data are added to the mix.*

- *Finally, bandwidth requirements can be reduced by a factor of 3 - 5 through enabling compression in the transport protocol. Web Services is layered on SOAP, which is layered over HTTP, which supports GZIP compression inline. When both the sending and receiving servers support such compression, which enables about a 3-5 fold reduction in bandwidth. In a few years, we can expect to see binary XML transmission enabled in SOAP exchanges, which can reduce bandwidth by a factor of 10 or more.*

  For an imaging exchange, the three primary factors driving bandwidth requirements are:

  1. Volume - how many procedures will be transmitted, will it be uni/bi-directional. Critical information because even if transmission time expectations for sending/receiving are low, the sending or receiving devises may encounter queue management problems.
  2. Files/data size - as expected, this will have a big impact.
  3. Expectations - for an exchange or teleradiology the key is to define how long it would take to transmit and receive (not always the same) data.
  Other factors play a role, such as transmission protocols and latency, but if we have a handle on the items above, we can size a circuit or recommend bandwidth requirements fairly well.

  For a system that archives images throughout the day, the following calculation can be used to assist in circuit sizing: (daily volume in bits) / (number of seconds during the day) = (circuit requirements in bits/sec)